

## CLAIMS

### 1. A light illuminating apparatus comprising

first radiating means of an optical structure having one or more light separating surface for transmitting and reflecting a light beam for splitting the light beam into a transmitted light beam and a reflected light beam, said first radiating means routing a sole light beam incident thereon through said one or more light separating surface to generate  $n$  light beams, where  $n$  is a natural number not less than two;

second radiating means of the same optical structure as said first radiating means, said second radiating means routing a sole light beam incident thereon through said one or more light separating surface to generate  $n$  light beams; and

light synthesizing means for synthesizing one light beam each of said  $n$  light beams radiated by said first radiating means so as to be incident on the light synthesizing means, and one light beam each of said  $n$  light beams radiated by said second radiating means so as to be incident on the light synthesizing means, to generate  $n$  light beams;

said light synthesizing means synthesizing an  $m$ 'th light beam, generated by said first radiating means, and an  $(n-m+1)$ st light beam, generated by said second radiating means, on one and the same axis, provided that the  $n$  light beams generated by said first radiating means and the  $n$  light beams generated by said second radiating means are ranked from a rank 1 to a rank  $n$  in the increasing order

of optical path lengths of said  $n$  light beams resulting from transmission and reflection along passageways of generation of said light beams,  $m$  being an optional number from 1 to  $n$ .

2. The light illuminating apparatus according to claim 1 wherein said light synthesizing means includes a beam splitting surface for splitting an incident light beam into two light beams on reflection and transmission, the  $n$  light beams radiated by said first radiating means being incident on said beam splitting surface from one surface thereof, the  $n$  light beams radiated by said second radiating means being incident on said beam splitting surface from the other surface acting as a back surface thereof;

a transmitted light beam of the  $m$ 'th light beam of said first radiating means and a reflected light beam of the  $(n-m+1)$ st light beam of said second radiating means are synthesized on one and the same axis; and wherein

a reflected light beam of the  $m$ 'th light beam of said first radiating means and a transmitted light beam of the  $(n-m+1)$ st light beam of said second radiating means are synthesized on another one and the same axis

3. The light illuminating apparatus according to claim 2 wherein said first radiating means radiates  $n$  light beams, arrayed parallel to one another on a plane perpendicular to said beam splitting surface, to said beam splitting surface; and wherein

said second radiating means radiates to said beam splitting surface  $n$  light

beams, arrayed parallel to one another on a surface, which is the same surface as that on which the  $n$  light beams radiated from said first radiating means are arrayed.

4. The light illuminating apparatus according to claim 1 wherein a light splitting optical system, included in each of said first and second radiating means, includes

first to  $j$ 'th  $j$  beam splitters, each including a light separating surface for separating an incident light beam into a transmitted light beam and a reflected light beam, by transmission and reflection, and for radiating the reflected light beam along a surface perpendicular to a beam splitting surface of said light synthesizing means, said light separating surfaces being arrayed parallel to one another,  $j$  being such that  $n = 2^j$  and being a natural number equal to or larger than 1; and

a reflecting mirror having a light reflecting surface for reflecting an incident light beam, said light reflecting surface being parallel to said light separating surface of each beam splitter, said reflecting mirror being arranged at such a position where the reflected laser beams from the totality of the beam splitters fall on said light reflecting surface; wherein

a sole light beam is incident in the first beam splitter, said first beam splitter radiating a sole transmitted light beam and a sole reflected light beam;

$2^{(k-1)}$  light beams, transmitted through the  $k$ 'th beam splitter, are incident on the  $(k+1)$ st beam splitter,  $2^{(k-1)}$  light beams, reflected by the  $k$ 'th beam splitter, are incident after reflection by said reflective mirror on said  $(k+1)$ st beam splitter, said  $(k+1)$ st beam splitter radiating  $2^k$  transmitted light beams and  $2^k$  reflected light

beams,  $k$  being an integer not less than 1 and not larger than  $(j - 1)$ ;

the  $j$ 'th beam splitter radiating  $2^{(j-1)}$  transmitted light beams to outside and radiating  $2^{(j-1)}$  reflected light beams to said reflective mirror;

said reflecting mirror reflecting the  $2^{(j-1)}$  reflected light beams of the  $j$ 'th beam splitter to radiate the resulting laser beams to outside; and wherein

the distance between the light separating surface of said  $k$ 'th beam splitter and the light separating surface of said  $(k+1)$ st beam splitter and the distance between the light separating surfaces of the beam splitters and the light reflecting surface of said reflective mirror are adjusted so that the difference of the optical path lengths of the optical paths of the light beam radiated from the light source will be larger than the coherence length.

5. The light illuminating apparatus according to claim 3 wherein

a distance  $t_k$  between the light separating surface of the first beam splitter and the light separating surface of the  $(k+1)$ st beam splitter is set so as to be not less than  $(2^{(j-1)} - 1) \times L / (2 \cos \theta)$ , where  $\theta$  is the angle of incidence of a laser light beam incident on each beam splitter,  $L$  is the coherence length of the light beams radiated from said light source and  $n$  is the refractive index of a medium between the light separating surfaces; and wherein

the distance between the light separating surface of the first beam splitter and the light reflecting surface of the reflective mirror is set so as to be not less than  $L / (2n \cos \theta)$ , where  $\theta$  is the angle of incidence of a laser light beam incident on each

beam splitter,  $L$  is the coherence length of the light beams radiated from said laser light source and  $n$  is the refractive index of a medium between the light separating surface of the first beam splitter and the light reflecting surface of said reflective mirror.

6. The light illuminating apparatus according to claim 5 wherein the light splitting optical system of the first radiating means and the light splitting optical system of the second radiating means are arrayed inverted relative to each other with respect to the arraying direction of  $n$  light beams radiated from said first and second radiating means.

7. The light illuminating apparatus according to claim 5 wherein the reflected light beam and the transmitted light beam, separated by said light separating surface of said beam splitter, has a light intensity ratio of 1:1.